

## **Applications of Synthetic Aperture Radar to Meteorology and Oceanography Command Operations**

Todd D. Sikora  
Millersville University  
P.O. Box 1002  
Millersville, PA 17551-0302

phone: (717) 872-3289 fax: (717) 871-4725 email: [Todd.Sikora@millersville.edu](mailto:Todd.Sikora@millersville.edu)

Grant Number: N00014-10-1-0569

### **LONG-TERM GOALS**

This research is an expansion of the ONR grant “Applications of Synthetic Aperture Radar to Meteorology and Oceanography Command Operations,” N00014-06-1-0046 (Dr. Todd D. Sikora), N00014-07-1-0934 (Dr. George S. Young) and N0014-07-1-0577 (Dr. Nathaniel S. Winstead). The expansion allows for the completion of publications that have resulted from that research.

### **OBJECTIVES**

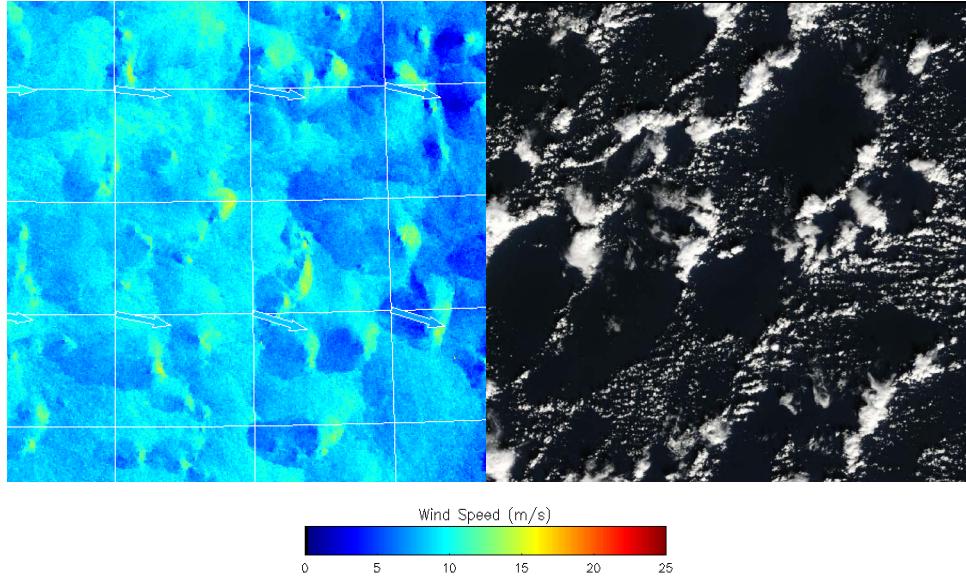
1. Our objectives are to complete publications related to:
  - a. A climatology of a variety of marine meteorological phenomena observed within a large archive of synthetic aperture radar (SAR)-derived wind speed (SDWS) images of the Gulf of Alaska. An example of one of these images can be viewed in Figure 1.
  - b. The documentation of the forcing, structure, and predictability of the convectively-driven open ocean squall / lull couplet features frequently seen within SDWS images and corresponding visible satellite images (see Figure 1).
  - c. The investigation of the frequent existence of atmospheric gravity wave signatures on SDWS imagery of gently sloped warm and occluded fronts (see Figure 2), and explanation as to why such signatures are not evident on SDWS imagery of steeply sloped cold fronts.
  - d. The documentation of an SDWS image-based automated verification / error warning system for mesoscale wind forecasts produced by numerical weather prediction models.
  - e. Related research funded by the National Oceanic and Atmospheric Administration on the determination of the accuracy of SDWS in the vicinity of mountain gaps under various large-scale weather situations (i.e., the development of an error climatology) and assessment of the impact of improved wind input wind directions in the calculation of SDWS.

## Report Documentation Page

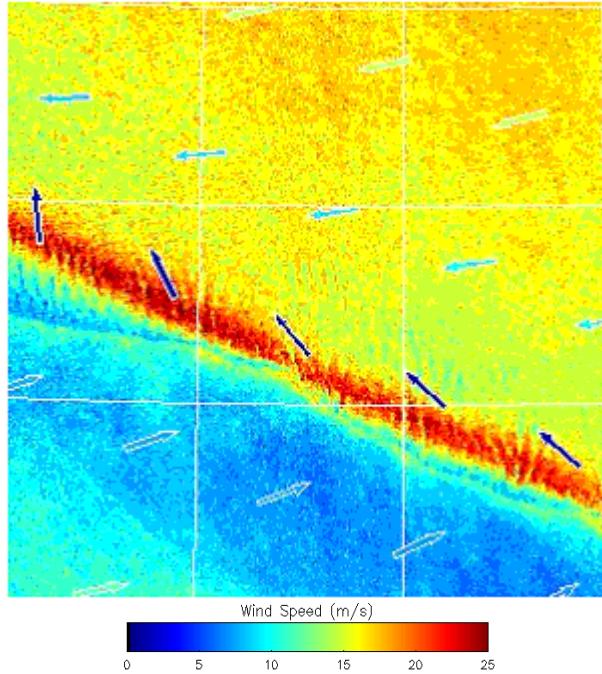
*Form Approved  
OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>2010</b>	2. REPORT TYPE	3. DATES COVERED <b>00-00-2010 to 00-00-2010</b>		
4. TITLE AND SUBTITLE <b>Applications of Synthetic Aperture Radar to Meteorology and Oceanography Command Operations</b>			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Millersville University, P.O. Box 1002, Millersville, PA, 17551-0302</b>			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>		
			18. NUMBER OF PAGES <b>3</b>	19a. NAME OF RESPONSIBLE PERSON



**Figure 1.** At left is a Radarsat-1 SDWS image depicting the quasi-circular signatures of convectively-driven open ocean squall / lull couplets. The 600 m pixel image is 450 pixels by 450 pixels. The image was acquired over the Gulf of Alaska at 0301 UTC on 8 November 2006. Arrows indicate NOGAPS model winds. (Provided courtesy of JHUAPL) At right is the closest corresponding MODIS image, a Terra satellite image of the region at 1955 UTC on 7 November 2006. The 250 m pixel image is 900 pixels by 900 pixels. It shows open-cell mesoscale cellular convection with a scale similar to the SDWS signatures. (Provided courtesy of NASA)



**Figure 2.** Radarsat-1 SDWS signatures of atmospheric gravity waves within a warm frontal region from 28 January 2004 over the Northern Pacific Ocean. Observed wavelength is  $3.67 \pm 0.6$  km. Arrows indicate MM5 model winds. (Provided courtesy of JHUAPL)

## APPROACH

The approaches for the research are described in the annual reports for ONR grants N00014-06-1-0046, N00014-07-1-0934, and N0014-07-1-0577.

## WORK COMPLETED

We recently submitted a refereed manuscript to the *Journal of Applied Meteorology and Climatology* associated with Objective 1b. The manuscript has been returned for minor revisions.

We have submitted a non-refereed manuscript to the *Seventeenth Conference on Satellite Meteorology and Oceanography* associated with Objective 1d. A corresponding refereed manuscript is being prepared.

## RESULTS

The results for the research are described in the annual reports for ONR grants N00014-06-1-0046, N00014-07-1-0934, and N0014-07-1-0577.

## IMPACT/APPLICATIONS

The impact/applications for the research are described in the annual reports for ONR grants N00014-06-1-0046, N00014-07-1-0934, and N0014-07-1-0577.

## TRANSITIONS

The transitions for the research are described in the annual reports for ONR grants N00014-06-1-0046, N00014-07-1-0934, and N0014-07-1-0577.

## RELATED PROJECTS

The related projects for the research are described in the annual reports for ONR grants N00014-06-1-0046, N00014-07-1-0934, and N0014-07-1-0577.

## PUBLICATIONS

Young, G.S., N.S. Winstead, and T.D. Sikora, 2010: A SAR-based error warning product. *Seventeenth Conference on Satellite Meteorology and Oceanography*, AMS, Annapolis, MD, 27-30 September 2010.

Sikora, T.D., G.S. Young, C.M. Fisher, and M.D. Stepp: A synthetic aperture radar-based Climatology of open cell convection over the Northeast Pacific Ocean. *J. Appl. Meteor. Climatol.* [refereed]